

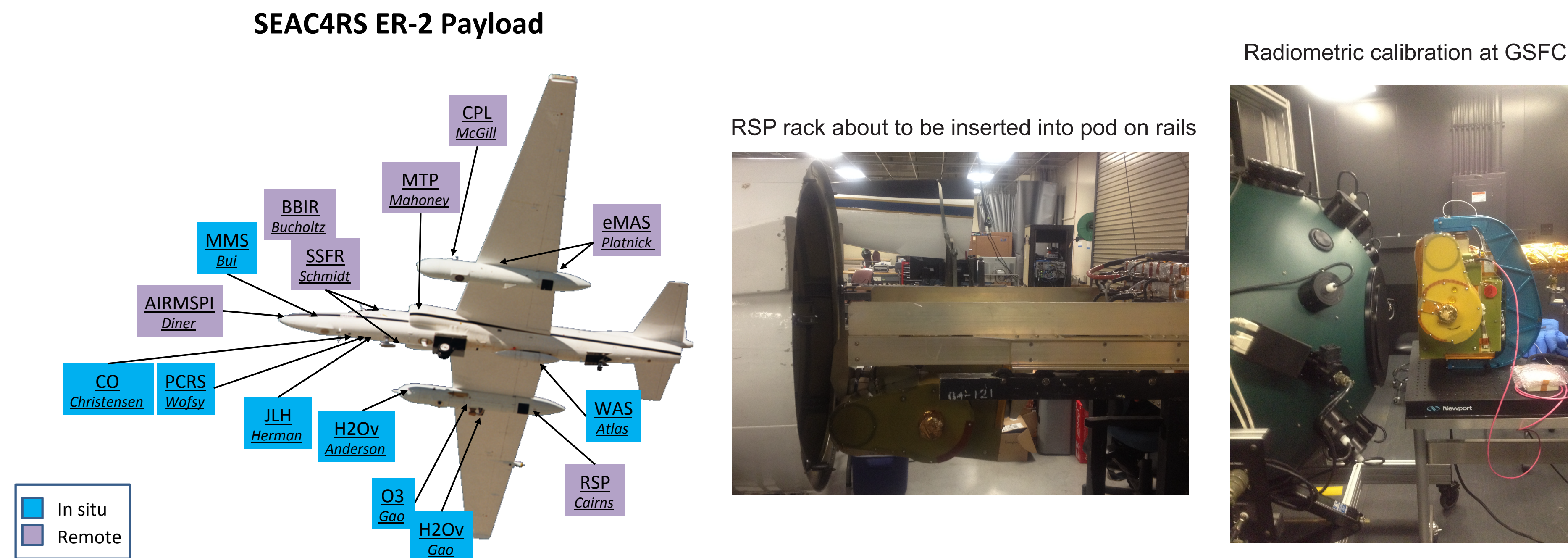
Initial aerosol retrieval results from the Research Scanning Polarimeter (RSP)

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1. The Measurements

The Research Scanning Polarimeter (RSP) was mounted on the NASA ER-2 during SEAC4RS. The RSP measures the Stokes vector elements I, Q and U simultaneously in nine spectral bands at 152 view angles as a polarization insensitive scanner rotates. This gives a view angle range of 120°. The RSP was mounted in the aft part of the superpod on the right wing with the scan plane was oriented along the aircraft axis. There is a pitch bias and some vignetting which yields a view angle range from -65° to +50°. The nine spectral bands are located at 410, 469, 555, 670, 863, 960, 1590, 1880 and 2260 nm with spectral widths of around 5%.



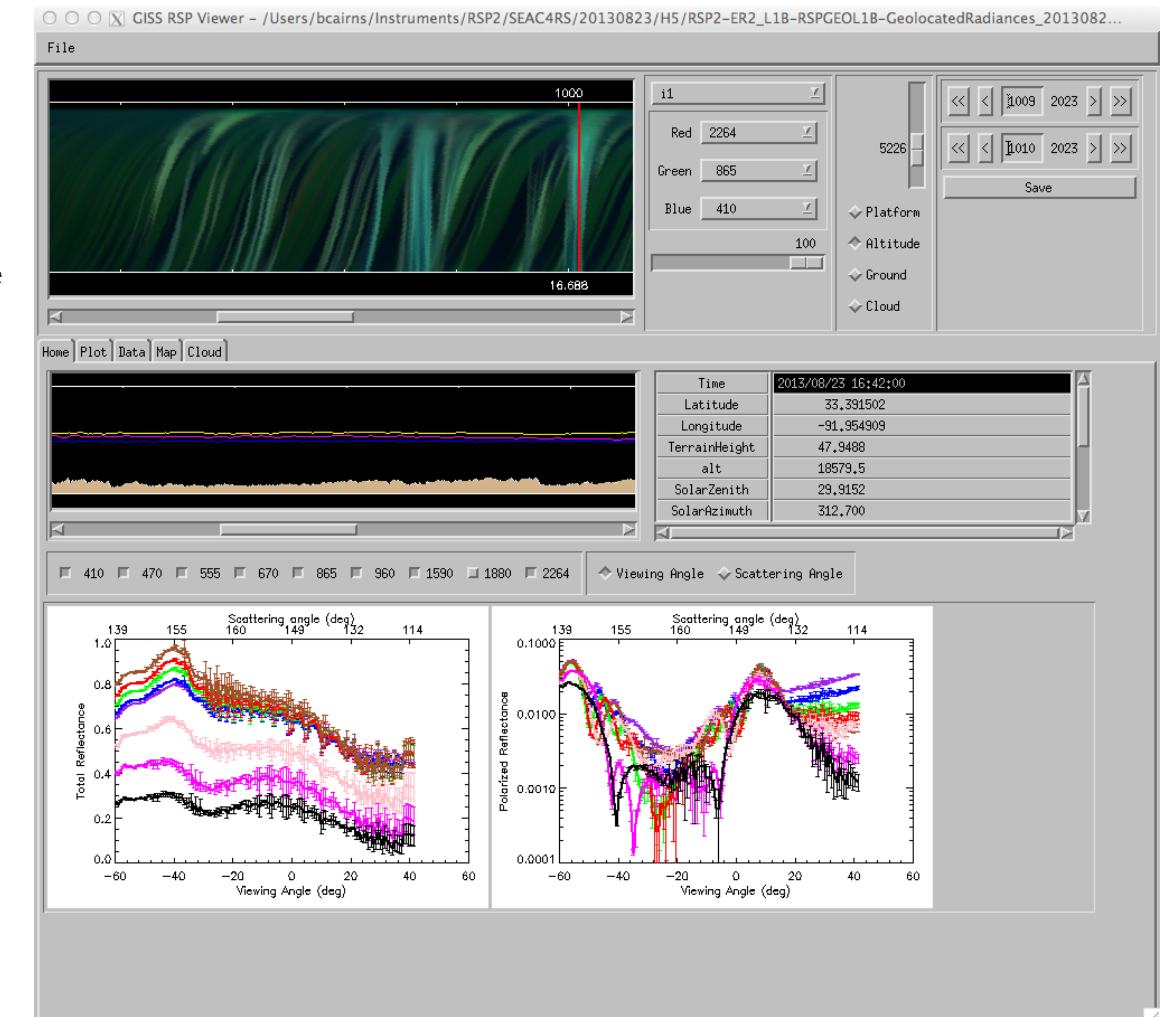
2. The Data

RSP data and tools are available at <http://data.giss.nasa.gov/pub/rsp/> as well as the Langley DAAC.

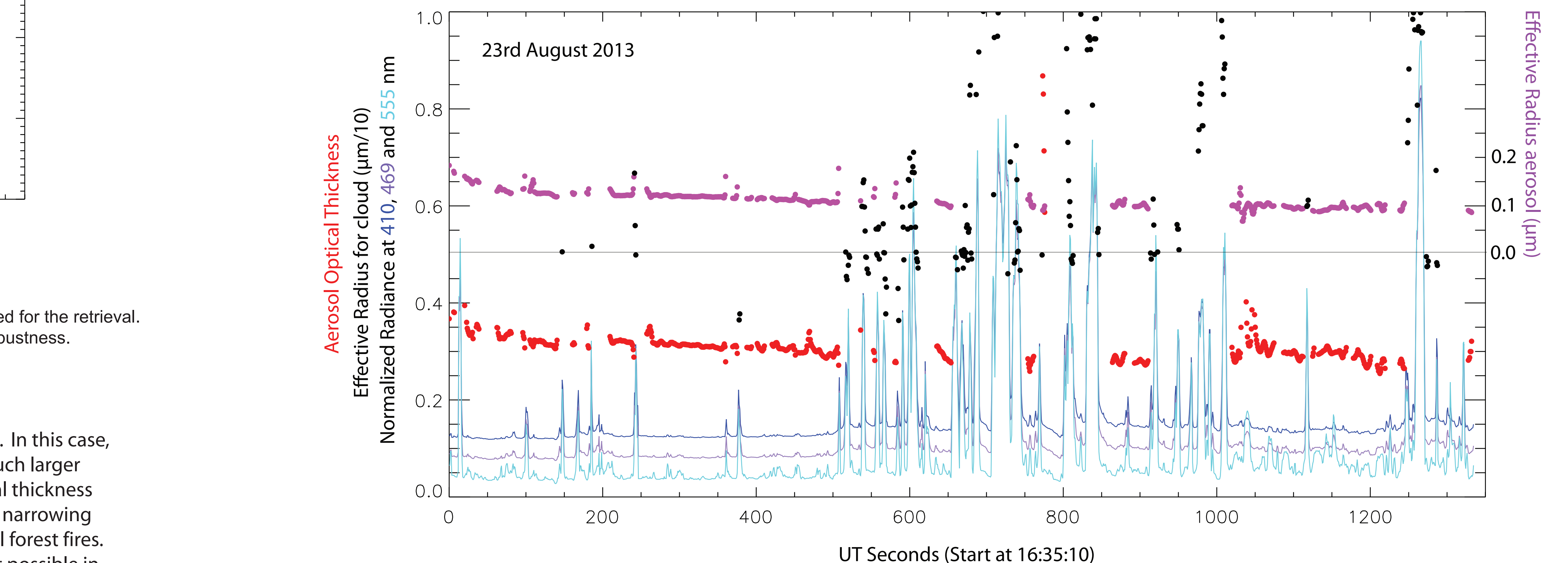
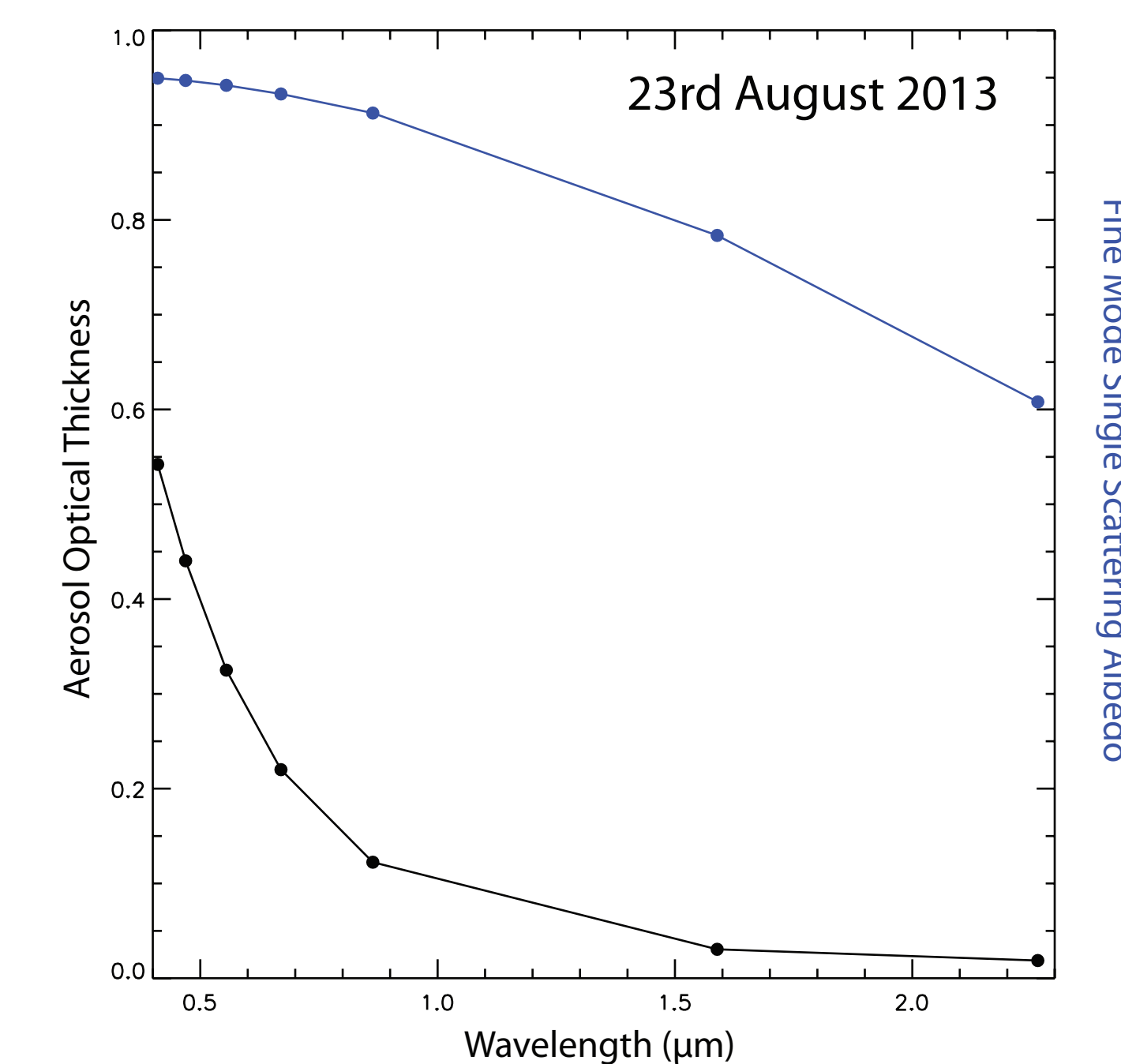


For broken clouds aggregation of data to cloud height allows for retrievals between clouds, where it is assumed that the aerosol is constant over the range of ground targets that are included.

An IDL viewer can be used to look at the RSP data aggregate it to a particular height and save a selected subset of data to a netCDF file. The arrays used to aggregate the data to a particular altitude are available in the RSP data files and allow aggregation to be done quite simply once a hyperstereo, or Rayleigh cloud estimate has been performed. The hyperstereo height estimate is included in the IDL viewer.

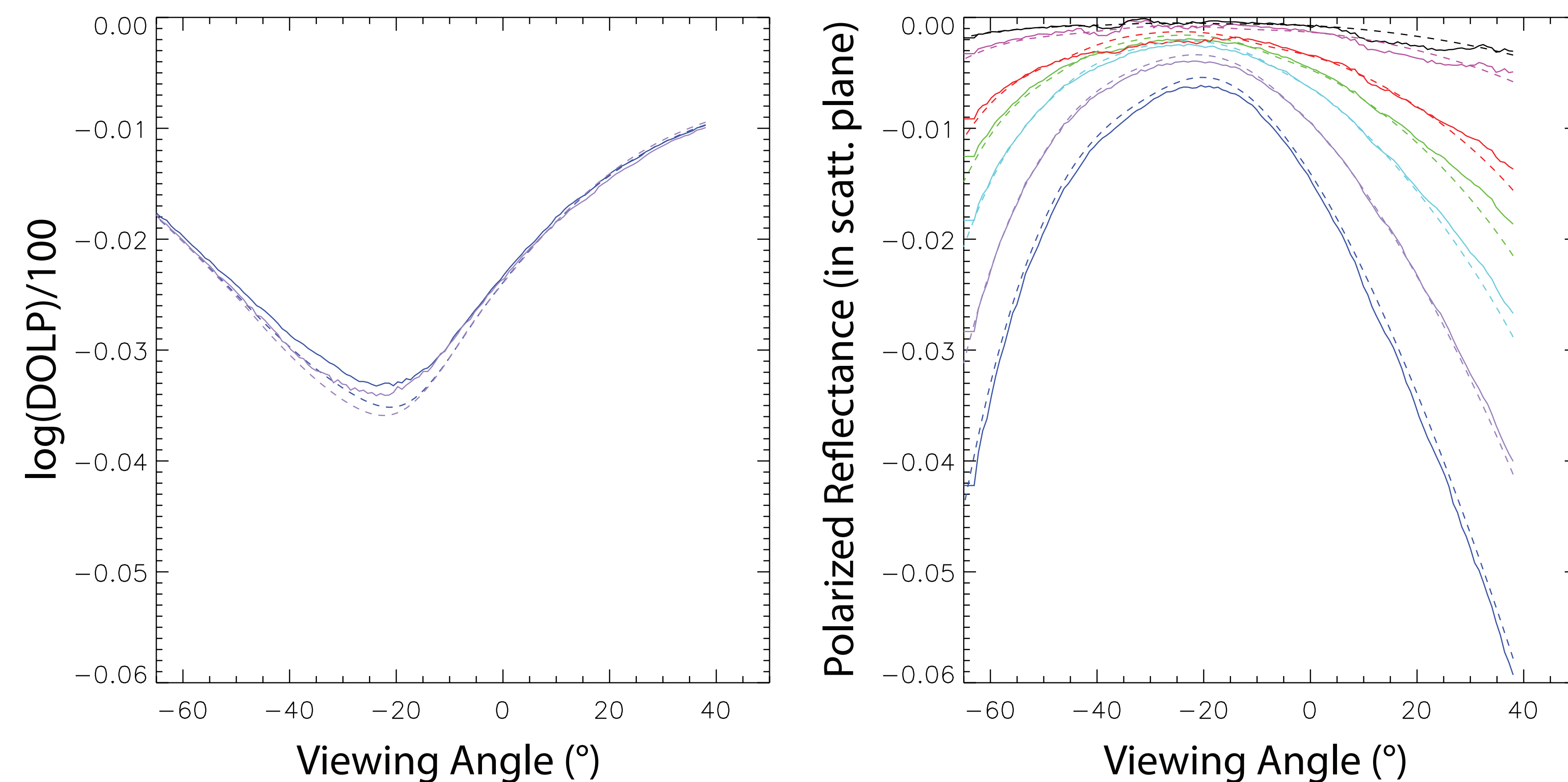


4. Spectral Variations



3. The Retrieval Approach

The retrieval uses a non-linear least squares iterative search for an aerosol model that best fits the polarized reflectance at 410, 469, 555, 670, 863, 1590 and 2260 nm and the Degree of Linear Polarization (DoLP) at 410 and 470 nm. Only these two bands are used with DoLP when doing retrievals in broken cloud, because they are dark (surface albedo ~ 0.04). For the other bands, since the aggregation is to cloud top, lots of different surface pixels are seen and constructing a surface model in such a case is sufficiently complex that using these bands for aerosol retrievals has limited value.



These figures show a typical fit for a retrievals that has converged. The residuals indicate that there are some limitations to the model being used for the retrieval. In general with such models there are tradeoffs between complexity (e.g. vertical profile details, aerosol properties changing with height) and robustness.

5. Conclusions

In retrievals from 08/23/2013 there are no obvious issues with the retrievals between the clouds and no apparent aerosol growth. In this case, where the aerosol burden has a substantial contribution from smoke above the clouds, this is not surprising. The clouds show much larger variations in particle size than the aerosols with the droplet size being strongly correlated with cloud top height and cloud optical thickness and anticorrelated with the effective variance of the size distribution. This is again not surprising given the expected growth and narrowing of droplet size distributions in convective plumes. The single-scattering albedo at 555 nm of 0.942 is typical of smoke from boreal forest fires. While it is possible to perform aerosol retrievals above cloud for these broken cloud fields using the polarized reflectance, it is not possible in these cases to make any use of the total intensity observations, because 3D effects (leakage from cloud side, shadowing etc.) are substantial and cannot effectively be incorporated into a plane parallel radiative model.

Acknowledgements

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